COMPOSITE FABRIC AND USE THEREOF

This invention relates to a composite fabric which may be used, for example, as, or as part of, closure means for vehicle bodies or other goods containers and/or as an architectural fabric.

In one application, the invention may be used as, or as part of, a side or end curtain of curtain-sided goods containers, that is, goods containers having in one or more sides and/or ends thereof a loading (or unloading) aperture which is closable by a sliding or roll-up curtain.

Curtain-sided vehicles have become firmly established in the road transport industry owing to the ease with which, when the curtains are retracted, they can be loaded and unloaded by means of fork-lift trucks. The curtains are normally sheets of polyester fibre reinforced polyurethane (PU) or polyvinylchloride (PVC) suspended at their upper edge portion by runners or sliders moving along a track disposed longitudinally of the vehicle body. Tension in the vertical dimension of the curtain is provided by the use of strap and buckle devices by means of which vertical reinforcements of the curtain, usually strips of webbing material, are secured to the respective side rave of the vehicle body.

Although curtain-sided vehicles enjoy considerable commercial success, they suffer from a disadvantage in that the conventional flexible PVC curtains offer little resistance to the action of thieves in slashing the curtains with knives or similar instruments and thereby gaining access to the interior of the vehicle body and its contents.

In another application, the invention may be used as, or as part of, an architectural fabric.

Architectural fabrics generally comprise a textile substrate coated with a polymer. Such materials are used in building construction, usually for roofing and/or partitioning, but can also be used for building closures (such as roll-up doors), tents and marquees. Architectural fabrics are less permanent than traditional rigid building materials, but for certain applications they have advantages. For example, architectural fabrics can be erected and dismantled more quickly and at lower cost, and they are often suitable for creative new types of design and styles of building such as widespan enclosures and tent constructions in which the fabric is extended and supported in curving and sloping constructions, similar to tents.

The textile substrate can comprise, for example, polyester, nylon, glass fibre or aramide (e.g. KEVLAR) fibres which are woven into a fabric. The polymer coating can comprise

polyvinylchloride (PVC), polyethylene, polypropylene, polyurethane, polyvinylidenefluoride (PVDF), polytetrafluoroethylene (PTFE) (e.g. TEFLON) or rubber.

Known architectural fabrics all suffer one or more disadvantages. Known substrates all support combustion with the result that a roof of known architectural fabric can quickly collapse in the event of fire. Most known substrates, especially polyester and aramide substrates, deteriorate when exposed to ultraviolet radiation and can only be provided with opaque coatings. Many substrates, especially nylon are susceptible to creep elongation. Many substrates suffer discoloration due to microbe growth in the interstices of the fabric. It is not possible to weld known substrates: current architectural fabrics are joined by stitching or by welding the coating which inevitably results in a fabric strength lower than the strength of the substrate and can, especially in the case of stitching, be difficult to effect for wide spans.

It is therefore an object of the present invention to provide a composite fabric which exhibits greater resistance to damage and/or deterioration.

According to one aspect of the present invention there is provided a composite fabric comprising a substrate and a coating applied to the substrate so as to form a continuous

sheet adhered to the substrate, wherein the substrate comprises a mesh of multifilament metal cord.

The substrate may be woven or unwoven. Ideally, the substrate contains no textile fabric, although the substrate may contain synthetic fibres and the coating may have a textile fabric laminated thereto.

The metal cords of the substrate can be disposed to one another in any convenient manner. Thus, they can, for example, be entwined with one another (for instance by weaving or other textile procedure) or overlaid and secured together, for instance by a melding or a bonding procedure. The metal cords can, for example, be present as continuous or discontinuous strands. Where the substrate is woven the warp and weft cords are conveniently arranged substantially at right angles to each other.

The interstices defined by the metal cords can be of any suitable shape and size. For example, where the cords are disposed in the form of a mesh, for example in a woven pattern or a welded mesh, the interstices of the mesh can be substantially square or of other rectangular shape. The side dimensions of such mesh interstices can be, for example in the range from 0.05 mm to 12 mm, preferably 3 mm to 10 mm, especially 5 mm to 10 mm.

In a further form of the invention the composite fabric contains two or more substrates of multifilament metal cord mesh. This form can comprise, for example, an assembly of two substrates in face-to-face relationship, the outer faces (or outermost faces where there are more than two substrates) having a coating applied thereto. An alternative structure comprises an assembly of two sheets of composite fabric according to the first aspect of the present invention, each sheet comprising a substrate having a coating on both faces thereof and the two sheets of composite fabric being secured together at the interface between adjacent surfaces of coating material. The number of substrates that can be used will depend on their flexibility and on the flexibility required in the composite fabric; the greater the flexibility of the components, especially the substrates, the greater the number of such sheets can be used.

In those embodiments of the composite material of the invention which contain more than one substrate, it is preferred that the pattern of the mesh of the substrate is not coincident in both or, where there are more than two substrates, in all of them, whereby the resistance of the composite fabric to damage, particularly slash attack, is enhanced. This non-coincidental pattern can be effected, for example, by providing that the direction of the metal cords is not identical in the two or more substrates so that the directions of the metal cords in adjacent

substrates are off-set from each other by an angle (for example an angle in the range from 5 degrees to 20 degrees, for instance about 10 degrees) and/or by offsetting the pattern of at least one substrate from that of the other substrate or substrates.

The multiple filaments of the metal cord may be twisted together as one or more strands or groups. The or each filament may have a diameter in the range from 0.05 mm to 1.25 mm, for example about 0.18 mm.

The cords are suitably made of steel in order to provide sufficient strength though, if desired, other metals can be used. The steel, particularly where mild steel is used, or other metal susceptible to corrosion may be provided with a corrosion-resistant coating. Suitable corrosion resistant materials are, for example, those known as being suitable for coating metal cords in radial tyres, for instance zinc, copper or brass. Alternatively the metal may be made of a corrosion-resistant alloy.

One or more strands of synthetic material may be incorporated into all or part of the cord or may be inserted intermediate at least some of the adjacent cords.

The coating may comprise a polymeric material, such as a thermoplastic polymer. The polymeric material may be selected from polyurethane, polyvinylidene fluoride (PVDF),

polytetrafluoroethylene (PTFE) and rubber. The polymeric material may incorporate at least one additional component. The additional component(s) may be selected from fillers, plasticisers, stabilisers, flame retardants, lubricants, pigments and dyes. The coating may be applied to the substrate by one or more of laminating, liquid extrusion and dipping.

The coating material is preferably present on both faces of the substrate. A preferred form of coating material is a layer of polyurethane applied to one or both faces of the substrate. If desired, the polyurethane can be applied to only one face of the substrate but, in general, it is preferred that it be applied to both faces. It is generally found that application of a polyurethane paste to one face of the substrate results in the polyurethane penetrating the interstices of the substrate thereby providing a securement for the coating. It is preferred that, whatever method is used to apply the polyurethane or other polymeric material coating to the substrate, it should result in the coating material becoming firmly bonded to the substrate, for example, by penetrating the interstices (or at least some of the interstices) between the cords of the substrate.

Although the invention is described herein with particular reference to the coating material being coated on the substrate by application of a paste composition, other

means can be used, for example by dipping the substrate into molten or semi-molten coating material, using the coating material in pre-formed sheet form and securing the sheet to the substrate by pressing, rolling or adhesive, or any combination thereof.

There is usually no need to use any supplementary securing means, for example adhesive or other bonding agent, between the substrate and the coating, provided that care is taken to ensure that satisfactory securement is attained, for example using the procedures referred to above.

According to another aspect the present invention there is provided a goods container, such as a curtain-sided vehicle body, provided with a curtain comprising a sheet of a composite fabric according to the first aspect of the invention; means to suspend the curtain from an upper portion of said container; and means to secure the curtain in place with respect to said container.

Whatever coating material is used, it should preferably provide the desirable characteristics of conventional PVC curtains used for curtain-sided vehicles, including flexibility and weather-proof, or at least weather-resistant, capability.

Not all of the composite fabric embodiments referred to in the first aspect of the invention are flexible enough for

satisfactory use in a curtain-sided goods container. However, these more rigid embodiments are suited for use as structural panels for more rigid goods containers, for example motor vans.

A sheet or sheets of composite fabric according to the first aspect of the invention can be used either for the whole area of the curtain or only for part of it. Where the composite fabric is used for the whole area, securement means of a suitable size, for example bolts of small diameter, can be used, said means passing through apertures between adjacent metal cords of the substrate or substrates.

In one form of curtain the composite fabric does not extend as far as the upper edge portion of the curtain, the upper edge portion being provided, for example, by a sheet of conventional curtain material secured to the upper edge of the composite fabric. In practice, this latter arrangement does not detract substantially from the security provided by the curtain, because most attempts to slash conventional curtains are made against the lower portion of the curtain.

For a better understanding of the present invention and to show more clearly how it may be carried into effect reference will now be made, by way of example, to the accompanying drawings in which:

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Figure 1 is a plan view of one embodiment of a composite fabric according to the present invention;

Figure 2 a side view of the composite fabric shown in Figure 1;

Figure 3 is an exploded of a part of a curtain-sided container incorporating a curtain including composite fabric as shown in Figures 1 and 2; and

Figure 4 is a cross-sectional view of one embodiment of a detail of the curtain-sided container of Figure 3.

The composite fabric shown in Figures 1 and 2 is intended for use in a curtain of a curtain-sided vehicle body or as an architectural fabric and comprises a substrate in the form of a mesh layer (i.e. a web or net) of metal cord 1 to which is applied a coating 3 of a suitable polymeric material to form a continuous sheet adhered to the substrate. However, it should be noted the composite fabric has other uses, such as floating water tanks for towing fresh water at sea, vandal-resistant coverings for seating, lifting/carrying bags for heavy, sharp materials such as aggregates, gravel and broken stone, and reservoir linings. When used as a curtain for a curtain-sided vehicle body, the composite fabric has the advantage that it is not only resistant to damage by vandals, but it is

also resistant to damage from the vehicle load and /or from a loader for loading and /or unloading the vehicle load.

The substrate is a mesh or fabric, with the cords 1 being composed, for example, of steel and consisting of a plurality of filaments which may be twisted together. A cord composed of a plurality of filaments has the advantage that it is more flexible than a single filament of similar weight per unit length. The number of filaments comprising a cord will depend on the requirements for any particular application, but can readily be determined. For example, nine or twelve filaments are particularly convenient, with the filaments being twisted first in small groups or strands (say three or four, or initially into groups of two and subsequently into groups of four) and the groups or strands then being twisted together. Each filament may have a diameter in the range of, for example, 0.05 mm to 1.25 mm, with adjacent cords being spaced by, for example, 0.05 mm to 10 mm. In one embodiment, both the warp and weft of the substrate may be of steel cord comprising three strands each of three filaments, the filaments having a diameter of about 0.18 mm and having a zinc coating as a corrosion-resistant layer, with adjacent cords being spaced by about 5 mm. The mesh or fabric may be in the form of a plain (square) or twill weave in which warp and weft cords pass under and over each other, an unwoven configuration in which the cords simply pass over each other, or may be knitted. The cords may be all of the same diameter or the

warp cords may have a greater diameter than the weft cords. Alternatively, the weft cords may have a greater diameter than the warp cords.

Ideally the steel is provided with a corrosion-resistant coating, for example it may be galvanised, or the steel may comprise a corrosion-resistant alloy, such as stainless steel. Where coated, the steel may be a low carbon steel having a carbon content of about 0.7 percent by weight. In order that the coating 3 should adhere more firmly to the steel cord, synthetic fibres (such as those conventionally used in architectural fabrics, e.g., nylon or polyester) can be incorporated into all or part of the cord or can be inserted intermediate the warp and/or weft cords.

Steel cords comprising multiple filaments as described possess high tensile strength and high resistance to any kind of damage, whether accidental or deliberate and whether physical or due to exposure to the environment.

The coating 3 comprises a suitable polymeric material, for example a thermoplastic material such as weather-resistant polyurethane (possibly with a flame-retardant finish), PVDF or PTFE. The polymeric material may incorporate one or more additional constituents such as fillers, plasticisers, stabilisers, flame retardants, lubricants, pigments and dyes. The coating is applied by laminating the coating to the surfaces of the substrate, by liquid extrusion onto the

substrate, or by dipping the substrate into a container of molten or semi-molten coating material, or indeed by a combination of extrusion and lamination. Thus, the coating may be transparent, translucent or opaque, may have a gloss or matt finish, may be left uncoated or may be covered with a lacquer or may have a textile material laminated thereto (such as of natural (e.g., cotton) or synthetic material). The overall thickness of the composite fabric may be of the order of 1.5 mm.

The metal cord substrate does not support combustion. Thus, although the coating 3 would degenerate in a fire, the substrate 1 would remain erect longer than a substrate of conventional material. The extension of the life of a building structure in the event of a fire, even if only by one or two minutes, could save lives.

A metal cord substrate has the advantage that it is completely unaffected by sunlight, thus permitting the use of clear, colourless coatings or of highly translucent coloured coatings. The metal cord permits the substrate to have an open mesh structure with the cords relatively widely spaced allowing the ready passage of light.

A metal cord, in particular a steel cord, is additionally relatively immune to creep elongation and does not support microbe growth. Moreover, a metal cord substrate offers

greater security in that it is more difficult to cut the fabric in order to effect unauthorised entry.

A particular advantage of the use of a steel cord is that the material of the substrate becomes weldable thereby resulting in a seam strength substantially the same as that of the substrate itself. This is a very significant advantage over known substrate materials. Alternatively, or additionally, the ends of the steel cord can be clamped to the steel cord substrate of adjoining sheets of the composite fabric or to frame structures or cables, again using the strength of the substrate rather than that of the coating.

The following Table shows, by way of example, characteristics of a woven sheet substrate and its warp and its weft cords. Preferred values for the various characteristics are shown under the heading "preferred range" and specific examples are shown under the heading "example".

TABLE

	Example	Preferred Range
Warp and Weft - steel filaments		
3 strands (or groups) of 3 filaments each of 0.18 mm diameter, the warp and weft cords each being spaced by 5 mm		
pics per m	200	180 to 220
cord diameter mm	0.73	0.63 to 0.83
linear density g/m	1.80	1.70 to 1.90
breaking force N	518	511 to 548
mass of zinc g/kg	72.5	68.9 to 81.2
Thickness of the woven sheet mm	1.52	1.2 to 1.65

The metal strands of the weft are uni-directional and the weft and warp cords are disposed substantially right angles to each other.

The polyurethane coating on the woven sheet substrate - in the present instance a coating on both faces of the substrate - had been applied in the form of a reactive polyurethane paste pre-mixed from its reactants shortly before application. The paste was applied, as a first coating, to the reverse face of the substrate (that is, the face to be disposed inwardly in the eventual composite fabric) followed by rolling, then, as a second coating to the obverse face of the sheet. Each coating penetrates the interstices of the substrate and comes into adhesive

contact with the other coating thereby to form a firmly bonded composite fabric.

Figures 3 and 4 show one embodiment of a curtain-sided container showing a container 11 having a floor 13 and a top 15 spaced apart by an upright post 17 provided at each corner of the container. As shown, mounted to one side of the container 11 is a curtain 19, although a curtain will generally provided along opposing sides of the container and could be provided at one or both ends thereof.

The curtain 19 comprises an elongate lower portion 21 which is made of the composite fabric and an upper portion 23 which is made either of the composite fabric or, for example, of conventional polyurethane (PU) or polyvinylchloride (PVC) based material. The lower edge of the lower curtain portion 21 is provided with a protective edging 25, for example of PVC based material. Similarly, the side edges 27 of the curtain 19 are made of a PU or PVC based material to provide sufficient flexibility for the curtain ends to be wrapped around, and secured to, an upright post 17. Spaced along the lower edge of the curtain are a plurality of conventional curtain buckles 29 for fastening the lower edge of the curtain to the region of the floor of the container. The upper edge 31 of the curtain is also made of PU or PVC based material in order to minimise any risk of damage to a pelmet (not shown) which is conventionally provided along the edge of the roof

15 for weatherproofing purposes. Provided along the top edge of the curtain are a number of roller assemblies 33 which run in a channel member 35 which is secured beneath the roof 15 of the container so as to suspend the curtain from the channel member.

It is not essential to provide lower and upper elongate curtain portions 21 and 23 or, where they are provided, it is not essential to provide the two portions of equal dimensions. Where two curtain portions of composite fabric are provided, they are joined along their edges and the join is covered by a cover strip 37.